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Development of high value cheaper pet food (Dog loaf) and its storage stability under Vacuum packaging at refrigerated temperature

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Abstract
Dog loaf was prepared using different percentages of slaughter house meat byproducts (Goat) and wheat flour at different percentages along with other non-meat ingredients and thus, three formulations were prepared i.e. 40% meat by-products+ 45.8 wheat flour (Treatment I), 50% meat by-products+ 35.8wheat flour (Treatment II) and 60% meat by-products+ 25.8 wheat flour (Treatment III). These products were packed in high-density polyethylene (HDPE) bags and sealed using the vacuum packaging method and kept at refrigeration temperature (4°C±1°C) for quality assessment. No significant differences were found in pH, crude protein, ether extract and Total ash in prepared dog loaves. However, significant difference could be observed in moisture, carbohydrate and calorie of the samples. The shelf life of the products was found to be safe up to 15 days under vacuum packaging at refrigerated temperature. The products were offered to dogs for sensory evaluation and found to be acceptable.

Keywords: Dog loaf, goat byproducts, non-meat ingredient, pet food

Introduction
With the rapid urbanization and increasing purchasing capacity of city dwellers, pet animals especially dogs are becoming an integral part of families and providing optimum nutrition to those pet animals has also become a concern to the pet owners. From time immemorial, pet animals especially dogs have been raised on left over foods which don't provide nutrition to the required level. However, with the growing popularity of pet animals, the demand for healthy and nutritious foods is increasing exponentially. Presently, the pet food market is multimillion dollar enterprise based on a wealth of scientific research and knowledge.
The commercial dog foods available in the market are very costly and all cannot afford to supply commercial dog food to their pets. Wide range of dog foods are made available where meat by-products are the common ingredient and price range is starting from Rs.160 to Rs. 210/kg [1]. By-products are rich in protein, fat and essential minerals and can effectively be utilized or recycled for production of various animal feed or food to generate additional income by 10-15% of the value of the live animals [2]. Efforts are made in this study to collect by-products from the slaughter house and to develop technology for preparation of balanced but cheaper pet food i.e. a new kind of dog loaf. This work will help in generating technology on recovering and converting the by-products into valuable end product in one hand and solving disposal and environmental pollution problem on the other hand. Dog loaf is a ready to eat pet food akin to bread consumed by human being. The product is handy, easy to carry home and cheaper in cost. There is a potentiality for establishing small manufacturing unit by small entrepreneurs

Materials and Methods
Ethical Note
The study was conducted in the laboratory of AICRP on PHET, College of Veterinary Science, Assam Agricultural University, Guwahati, India. The animal experimental protocol was approved by the Institutional Animal Ethics Committee (IAEC) and carried out as per the guidelines of Committee for the Purpose of Control and Supervision of Experiments in Animals (CPCSEA), Ministry of Environment, Forests and Climate Change, Government of India.

Sample collection and experimental design
By-products (Goat) were collected from local market and then thoroughly washed with clean potable water to minimize the contamination. The by-products were minced and kept aside to prepare three different formulations. Three formulations were prepared using meat by-products and wheat flour at different percentages i.e. 40% meat by-products+ 45.8 wheat flour (Treatment I), 50% meat by-products+ 35.8 wheat flour (Treatment II) and 60% meat by-products+ 25.8 wheat flour (Treatment III) along with other non-meat ingredients which were kept constant, the recipe for which is presented in Table No. 1. Both meat and non meat ingredient were mixed properly to form emulsions. The emulsions were placed in stain less steel frames and then cooked in cooking vat at 85ºC for 1 hour. The loaves thus prepared were packed in high-density polyethylene (HDPE) bags and sealed under vacuum and kept at refrigeration temperature (4°C±1°C) for shelf life study and quality assessment. The sensory evaluation of the products was conducted by feeding the loaves to different dogs. The costs of production of the products were determined by calculating the raw materials and processing cost. The shelf life study was conducted by determining the bacterial load until the products exceed the limit of higher bacterial load i.e. Log 5.0 cfu/g.

Table 1: Recipe for Preparation of Dog Loaf

Different meat and non-meat ingredients (%)	Treatment 1 (%)	Treatment 2 (%)	Treatment 3 (%)
Goat byproducts	40	50	60
Wheat Flour	45.8	35.8	25.8
Soya Flour	8	8	8
SMP	2	2	2
Fat	1	1	1
Mineral Mixture	2	2	2
Salt	1	1	1
Sodium Benzoate	0.2	0.2	0.2
Water	qs	qs	qs
Total	100	100	100

Parameters
pH: The hydrogen ion concentration (pH) of the dog loaf were determined by using a pH Meter (Cyberscan 1000 Euteoh instruments).

Proximate composition
Moisture, crude protein, crude fat and ash contents of all the samples of different treatment groups were determined by following the standard methods as described by AOAC in 1995 [3].

Carbohydrate = 100- (moisture% + fat% + protein % + ash %)

Calorific Value: Total carbohydrate values were calculated by difference using the following formula for 100 g of food {100- (moisture% + fat% + protein % + ash %)}

Shelf life studies
The shelf life of the products was conducted on 0,5,10 and 15 day storage at refrigerated temperature. The shelf life was decided on the basis of bacteriological quality, physical change and acceptability by the dogs.

Bacteriological quality
The total bacterial load (mesophillic count) was assessed as per the method described by following the pour plate technique as described by Harrigan and McCance in 1976 [4].

Acceptability test
The dog loaves were fed to five (5) different dogs reared by different owners as well as to street dogs. The feeds were presented to the dogs at least for 3 days in the morning hours withdrawing the normal food provided by their owners, however, the street dogs were fed instantly without following any restriction to food. The palatability of the dog loaf was determined on the basis of preference and acceptance by the dogs. Selected processing effects such as fat source and moisture content with sensory analysis techniques [5]. These authors focused on selected pet food sensory properties such as aroma and appearance.

Fig 1: The products by 40% 50% and 60%

Cost of production
The costs of the finished dog loaves were determined on the basis of cost of raw materials and processing cost.

Statistical Analysis
The data collected for the various parameters were subjected to statistical analysis using analysis of variance method (SAS Enterprise Guide 4.2).

Results and Discussion
The results of physic-chemical qualities i.e., pH, Proximate Analysis, Carbohydrate, Total Calorie and cost of production of dog loave are presented in Table-2.

Table 2: Results for pH, proximate analysis, Carbohydrate and Total Calorie of dog loaf

Parameters/Treatments	Treatment I	Treatment II	Treatment III
pH	6.38±0.194^{A}	6.12±0.225^{A}	5.84±0.391^{A}
Moisture	44.23±2.676^{B}	46.07±2.527^{BA}	53.76±2.131^{A}
CP	14.92±1.881^{A}	16.55±0.386^{A}	17.13±1.295^{A}
EE	2.36±0.146^{A}	2.38±0.141^{A}	2.54±0.130^{A}
Total Ash	2.09±0.172^{A}	2.16±0.068^{A}	2.76±0.387^{A}
Carbohydrate	36.32±1.327^{A}	32.49±2.097^{A}	23.80±1.308^{B}
Total calorie(per kg)	2268±105.313^{A}	2143.66±119.208^{BA}	1865.66±86.240^{B}
Cost of production(Rs.)/Kg	140.00	145.00	150.00

*Means with the same letterare not significantly different
*n=3, mean ± SE with different superscripts row wise (capital alphabets) differ significantly (p<0.05). SE=Standard error

There was no significant differences among the mean pH values of dog loaf. However, treatment I has shown higher pH compared to other treatments. The pH of meat balls with 5, 10, 15, and 20% of wheat bran ranged from 5. 91 to 6.11 and increased significantly with the increase in wheat bran. The highest pH value was obtained in meat balls containing 20% wheat bran [6].

The moisture content of Treatment III i.e. with 60% meat byproducts was found to be significantly higher (p<0.05 as compared to the Treatment I and Treatment II. Statistical analysis revealed that crude protein content of dog loaves was not significantly different among the treatments, however, Treatment-III has shown higher protein content compared to the Treatment-I and II. No significant differences with respect to ether extract and total ash of dog loaves were found. Treatment-III has shown higher ether extract content compared to the Treatment-I and II. Meat balls with added wheat bran at 5, 10, 15, and 20% levels showed lower moisture and fat content with increasing amount of wheat bran. Crude Protein and total ash content of the products gradually increased [6] and which might be due to the fact that wheat bran contains high ash content (6.7%) [7].

The carbohydrate contents of the dog loaves for different treatments decreased with the increase of the byproducts in the formulations. Significantly (p<0.05) higher carbohydrate content was found in treatment I which was prepared with 40% meat byproducts. Similar trend as carbohydrate has been observed in case of total calorie content of dog loaves.

Cost of production was found to be comparatively higher in Treatment III with 60% meat byproducts and 25.8% wheat flour. The cost of dog loaf prepared in the study was found to be lower than the cost of commercially available pet foods.

Shelf-life studies of the dog loaf

The products were tested up to 15th days of their storage life at refrigerated temperature for total plate count and Colititre. The total plate count for Treatment I could count only on 15 day storage and Treatment-I and II. No Colititer (MPN/g) count for all the treatment groups till 15th day of storage periods under vacuum packaging has been observed. The Coliforms counts were either not detected by the method used or when detected were very low in numbers indicating uniform and better sanitary measures adopted during processing of dog loaf. The low coliform and yeast and mould counts were in accordance with Sutherland *et al.* [8] on vacuum packed beef and with Babji *et al.* [9] on vacuum-packed minced goat meat. Rajkumar *et al.* [10] reported that Vacuum packaging had definite advantage in preserving the sensory quality of goat meat patties as only few samples shown deteriorative changes after 15 days and became unacceptable on day 25.

Table 3: Shelf-life studies of the dog loaf stored under vacuum packaging condition at refrigerated temperature (4°C±1°C)

Treatments/ Days	1st day	5th day	10th day	15th day
Total plate Count(log_5cfu/g)				
Treatment I	-	-	-	3.60±0.05^{B}
Treatment II	-	-	2.51±0.12^{A}	3.50±0.14^{B}
Treatment III	-	-	2.60±0.10^{A}	3.70±0.13^{B}

n=3
Means with the same letter are not significantly different
Means with different superscripts column wise (capital alphabets) differ significantly (p<0.05). SE=Standard error

Conclusion

Based on the study, it can be concluded that the meat byproducts from slaughter house and other non-meat ingredients could be utilized for the preparation of cheaper dog loaf. Vacuum packaging of dog loaf during storage under refrigeration improved the conducive for microbial growth. The products are cheaper than that of conventional pet foods available in the market. The study also indicated that entrepreneurship on the production of pet food may be developed in the city with lower initial production cost.

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